

What is claimed is:

1 1. A semiconductor device comprising:  
2 a substrate;  
3 a barrier film having a monolayer of barium atoms on said  
4 substrate; and  
5 ~~a material on said barrier film.~~

1 2. A semiconductor device comprising:  
2 a substrate material having a surface;  
3 a barrier film on said substrate surface, said barrier film  
4 having a monolayer of barium atoms attached to said surface;  
5 a conductor on said barrier film, said conductor having a  
6 tendency to diffuse into said substrate material if in direct  
7 contact therewith; and wherein said monolayer serves as a  
8 barrier, inhibiting diffusion of the conductor into the substrate  
9 material.

1 3. A semiconductor device according to claim 2, wherein said  
2 barrier film has a thickness of not more than approximately  
3 100Å.

1 4. A semiconductor device according to claim 2, wherein said  
2 barrier film has a thickness of not more than approximately 20Å.

1 5. A semiconductor device according to claim 2, wherein said  
2 barrier film has a thickness of not more than approximately 5Å.

1 6. A semiconductor device according to claim 2, wherein said  
2 barrier film is a single monolayer of barium atoms attached to  
3 said surface of said substrate material.

1 7. A semiconductor device according to claim 2, wherein said  
2 barrier film comprise a plurality of contiguous monolayers of  
3 barium atoms located on said surface of said substrate material.

1 8. A semiconductor device according to claim 2, in which said  
2 substrate material is a semiconductor.

1 9. A semiconductor device according to claim 2, in which said  
2 substrate material is a silicon semiconductor.

1 10. A semiconductor device according to claim 2, in which said  
2 substrate material is an insulating material.

1 11. A semiconductor device according to claim 2, in which said  
2 substrate material is silicon oxide.

1 12. A semiconductor device according to claim 2, in which the  
2 conductor is a metal.

1 13. A semiconductor device according to claim 2, in which the  
2 ~~conductor comprises copper.~~

1 14. A process for making a semiconductor device comprising the  
2 steps of:

3 forming, on a surface of a substrate material, a barrier  
4 film having a monolayer of barium atoms immediately adjacent said  
5 surface of the substrate material; and

6 depositing a material on said barrier film.

1 15. A process for making a semiconductor device comprising the  
2 steps of:

3 forming, on a surface of a substrate material, a barrier  
4 film having a monolayer of barium atoms immediately adjacent said  
5 surface of the substrate material; and

6 depositing a conductor, having a tendency to diffuse into  
7 the substrate material, onto said barrier film, wherein said  
8 monolayer inhibits diffusion of the conductor into the substrate  
9 material.

1 16. A process according to claim 15, in which the step of  
2 forming said barrier film comprises depositing a monolayer  
3 precursor compound on said substrate by molecular beam epitaxy,  
4 and then annealing said monolayer precursor compound to form said  
5 monolayer.

1 17. A process according to claim 15, in which the step of  
2 forming said barrier film comprises depositing a monolayer  
3 precursor compound on said substrate by sputtering, and then  
4 annealing said monolayer precursor compound to form said  
5 monolayer.

1 18. A process according to claim 15, in which the step of  
2 forming said barrier film comprises depositing a monolayer  
3 precursor compound on said substrate by physical vapor  
4 deposition, and then annealing said monolayer precursor compound  
5 to form said monolayer.

1 19. A process according to claim 15, in which the substrate  
2 material is selected from the group consisting of a semiconductor  
3 material and an insulating material.

1 20. A process according to claim 15, in which the conductor  
2 comprises copper.

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